The Relationship between Defence Spending and Economic Growth:
A Granger Causality Analysis for Malaysia, 1961 to 1999

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During the many occasions since the 1970's that the Defence Resources Management Institute has lectured at the Malaysian Armed Forces Defence College, a question has consistently arisen regarding the relationship between defence expenditures and the Malaysian economy. In other words, participants have been interested to see if defence spending has helped or hindered the Malaysian economy, or whether in fact there is little or no discernible effect on the economy?

This article looks at the relationship between the real (i.e. inflation adjusted) growth rate of the defence burden -- defence expenditures as a percent of the Gross Domestic Product (GDP) -- on the one hand, and the real growth rate of GDP on the other hand. We are mainly interested in the direction of causality: do changes in GDP lead to significant changes in defence expenditures or, vice versa, do defence expenditure changes lead to corresponding changes in GDP? Granger causality tests are run on the respective data for Malaysia from 1961 to 1999. The results support the widely-held notion that defence significantly influences Malaysian GDP while little evidence found to support the hypothesis that GDP influences defence expenditures. We feel that these results will be of interest to Malaysian policy planners in light of the recent Asian "slowdown" and the almost global intents to cut defence spending.

INTRODUCTION

Ever since Benoit's[1] seminal work in the 1970's, economists, political scientists and policy

planners have closely examined the question of what is the impact of defence expenditures on

the economy, and specifically, economic growth. By 1986, however, Deger, in analyzing the

economic effects of military expenditure on variables such as growth, saving, investment and

human capital, remained concerned about the lack of meaningful studies:

> The level of military expenditure and its share in the national product in
> Third World countries and high and rising. This is of great concern to us all.
> The issues are complex and need to be studied with care; yet the literature is scant."[2]

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While this question has generated a significant amount of attention, the impact of defense on economic growth – i.e. the relationship between the two variables – remains an unanswered question.[3]

A major thrust of the research to date has been to follow up on the initial findings of Benoit who, contradicting the prevalent view at the time, found a <u>positive</u> relationship in those developing countries which spent a large proportion of their budget on defence (i.e. the defence burden) and their economic growth. However, the multitude of studies which were prompted by Benoit's findings have often been contradictory since the results have depended on groupings of countries (e.g. by regime, geographic region and the like), by type of study (time series, cross-section, or panel), on the time period chosen or by the nature of the variables (levels or growths). An excellent review of the literature is provided by Sandler and Hartley.[4]

Another major thrust of recent research has been toward trying to uncover the direction of causality. Assuming that a relationship exists between defence expenditures and economic growth, what is the direction of the relationship? Does defence prompt later economic growth and can thus be viewed and modeled as the independent variable? Or does economic growth induce higher levels of defense expenditure, i.e. is defence expenditure dependent on economic growth? In other words, we are attempting to see whether defence expenditures causes economic growth, whether growth (changes in Gross Domestic Product (GDP)) induces increases in , or whether a symbiotic relationship exists between the two. Of course, also possible is a finding of no relationship between the two or a "feedback" pattern whereby defence prompts growth which in turn prompts more defence, and so on. The focus of this paper is to test for causality between real growth in the defence burden (defence as a percent of GDP) and real growth in GDP in Malaysia between 1961 and 1999.[5] The data and sources appear in the Appendix.

In the following sections, we discuss the issue of causality (and the necessary statistical tests) and examine some of the recent literature. Following that we present the results obtained for Malaysia and finally suggest some areas for further research.

REVIEW OF THE LITERATURE

In his early work, Benoit used a sample of 44 countries and estimated the following regression model:

$$AG = a + bAB + cAI + dAR + \varepsilon$$

where AG represents the average real annual growth of Gross National Product between 1950 to 1965, AB defence expenditures as a % of GDP, AI the gross capital formation as a % of GDP, AR the net receipts of bilateral aid, and ε the error term having the usual statistical assumptions. The estimated coefficients are a, b, c, and d. He concluded that his results indicated a strong positive relationship between growth and defense.

It is interesting to note that even in this study, Benoit recognized the issue of causality. While he broached the topic, he assumed that causality ran from defence to growth:

> A question arose, however, about the direction of this interaction. Might not the correlation be explained by the influence of growth rates on defence expenditures rather than vice versa? Countries with rapid growth might feel better able to indulge themselves in the luxury of elaborate defence programs . . . the direct interaction between growth and defence burdens seems to run from defence burdens to growth rather then vice versa. It seems clear that in the sample countries higher defence burdens stimulate growth.[6]

Several years later, Chang, Hsiao and Keng tested for Granger causality[7] and found that growth did not cause defence.[8] In an excellent 1985 review of the literature, Chan noted that to:

> " . . . tackle questions such as the impact of military spending on economic performance, we need dynamic analysis to determine the temporal leads and lags, the reciprocal influences among the variables, and over-time changes in the empirical parameters.[9]

Testing for Granger causality in a dynamic framework suggested by Chan, Joerding checked for ". . . the assumed exogeneity of military spending relative to economic growth in previous studies . . ."[10] Using a sample of 15 observations from 57 countries, he argued against the exogeneity (i.e. assumed independence) of defence expenditures and suggested earlier studies might be flawed. He concluded that " . . . it is reasonable to assume that economic growth is an endogenous [i.e. independent] variable."[11]

Obviously the determination of whether defence is exogenous or endogenous is of critical importance to policy makers in their attempts to find way to prompt – or at least not hurt -- economic growth. Frederiksen and LaCivita[12] argued that, while Joerding's paper was an important contribution to the literature, there were two major faults with his work. Firstly, Joerding lumped all countries into one sample thereby suggesting a causal relationship (if any) is common to all countries, and secondly Joerding assumed an arbitrary lag of four years – the time it takes for one variable to influence the other variable. Frederiksen and LaCivita suggested that the lag structure could well differ among countries depending on the nature of the country being examined. For the Philippines between 1956 and 1982, they found no (statistically) significant relationship between defence and growth with the lag structure arbitrarily set at four years. When the lag was set arbitrarily at two years a significant relationship was uncovered. In another 1991 paper, LaCivita and Frederiksen[13] examined defence spending and growth for 21 developing countries. The results indicated a feedback relationship for the majority (ten) of the countries, a growth to defence relationship for four of the countries, a defence to growth relationship for three countries, and no relationship for the remaining four countries. In a paper examining Indonesia, Frederiksen[14] found that a feedback relationship existed between the years 1964 and 1985. The causality question for Malaysia, Singapore, South Korea, Philippines (1982-1988) and Indonesia (1961-88) were looked at by Frederiksen in 1991.[15] Interestingly the

only countries where defence was found to Granger cause defence were Singapore and Indonesia

No relationship was found for the Philippines and South Korea and growth Granger caused

defence in Malaysia.

It is noteworthy to mention that by extending the years in the study, the results for the

Philippines and Indonesia were different than those found in the earlier studies by Frederiksen

and LaCivita and Frederiksen, respectively. A similar occurrence seems to have happened for

Malaysia. In 1994 Kusi reported the results for 77 developing countries using data through

1991.[16] As Kusi noted:

> For Indonesia, Malaysia, Pakistan, and South Korea, high defence spending appears to
> stimulate economic growth. This finding is in sharp contrast with those findings reported
> in Chowdhury[17] where in no case did defence spending help economic growth.[18]

On the other hand, Algeria, Brazil and Malawi indicated <u>negative</u> unidirectional causality from

defence to growth. What makes this result is that the four countries exhibiting a positive

relationship are all South Asian, and also that for 80% of the countries Kusi found no

relationship between defence and growth whatsoever. Since the results seem to be time sensitive,

this paper will extend the analysis for Malaysia through 1999. Before reporting the results, the

next section briefly examines Granger causality and lag structures.

GRANGER CAUSALITY AND OPTIMAL LAG LENGTHS

This section describes the Granger causality methodology and also the way in which an optimal

lag length is chosen. By using Hsiao's method for calculating lag structures,[19] we avoid

arbitrarily setting the lag length to some assumed length. Hsiao's method combines Granger

causality and Akaike's final prediction error (FPE) to determine the causal relationship, if any,

between two variables.[20]

To calculate optimal lag lengths, a series of M regressions are estimated where the independent variable is for example G_t (economic growth in time period t), and where the independent variable is the lagged value of G (or G_{t-i}):

$$G_t = a + \sum_{i=1}^{m} b_{t-i} G_{t-i} + e_t$$

where M can take on the value 1 to M and ε is the rror term with the usual statistical properties. The FPE, i.e. the "error" or calculated difference between actual and estimated values, was calculated as:

$$FPE(m) = \frac{T+m+1}{T-m-1} ESS(m)/T$$

where T is the sample size, and FPE(m) and ESS(M) are the final prediction error and sum of squared errors, respectively. The optimal lag length, m*, is the lag length with the smallest difference between actual and estimated values – i.e. the lowest FPE. Given m* we calculate additional regression equations with the another lagged independent variable D_{t-i} (the defence burden) added sequentially in the same manner as used to determine m*:

$$G_t = a + \sum_{i=1}^{m^*} b_{t-i} G_{t-i} + \sum_{i=1}^{n} g_{t-i} D_{t-i} + e_t.$$

The FPE now becomes:

$$FPE(m) = \frac{T+m+n+1}{T-m-n-1} ESS(m,n)/T$$

The optimal lag length for D, i.e. n* ,is chosen as the lag producing the lowest FPE.

To test for causality, the FPE with D omitted from the model is compared with the FPE with D included. If FPE(m*)<FPE(m*,n*) we can conclude that defence spending does not Granger cause economic growth. If FPE(m*)>FPE(m*,n*), the opposite is true – defence Granger causes

growth. We then perform the same test with economic growth (G) as the dependent variable and defence as the independent variable and again compare the FPE. If FPE(m*)>FPE(m*,n*) in both cases where D and G are independent variables, we can conclude a feedback relationship. If FPE(m*)<FPE(m*,n*) in both cases then we conclude no relationship exists between the two variables.[21]

RESULTS

As noted above, we examine defence expenditures for Malaysia between 1961 and 1999. The sample size depends on the lag length. The most observations we had were 38 when we estimated, in turn, $G_t = f(G_{t-1})$ and $D_t = f(D_{t-1})$. We chose to limit the number of lags as eight years which then resulted in sample sizes of 31. The FPE results are as follows (G_L and D_L indicate lagged values of the variables):

Model	m*	m*, n*	Optimal Lag (Yrs.)
(1) $G = f (G_L)$	13.82		1
(2) $G = f (G_L, D_L)$		13.57	1, 1
(3) $D = f (D_L)$	0.53		2
(4) $D = f (D_L, G_L)$		0.53	2,1

Comparing models 1 and 2, since the FPE declines as we add the defence variable, we conclude that defence Granger causes growth for Malaysia – a finding which supports that of Kusi.   The FPE for models 3 and 4 are identical indicating that economic performance adds little in terms of predictive power for levels of defence spending. Of special interest to Malaysian policy makers are that the optimal lag lengths for all models are either 1 or 2. This suggests that the effects of defence on economic growth are quite in Malaysia where defence spending in one year affects growth in the following year.

Some have argued that defence no longer plays an important role Malaysian economic growth. Our results do not support this position. While we recognize the opportunity costs of defence allocations – the alternative uses for defence budgets -- efforts to cut Malaysian defence spending may have unintended negative results on the economy of Malaysia. We have not been able to examine the composition of defence budgets, i.e. capital outlays versus operations and maintenance. We would imagine that the former would have a much larger positive effect on the economy. Inasmuch, we assume that the ambitious procurement plans for modernizing the Malaysian defence forces will very probably have a large impact on economic growth. Our results are in no way meant to denigrate the myriad of alternative methods to prompt growth in Malaysia – e.g. globalization, or technology advances.   Instead, by extending our results through 1999, we show that defence can play a positive role for growth in the country and that recent economic slowdowns in the region have not yet affected this positive contribution of defence.

SUMMARY AND CONCLUSIONS

This paper has examined the relationship between economic growth and defence spending for Malaysia. Specifically, we were interested in the direction of causality, if any, between the two variables. Recent studies have shown that for many countries, there is no relationship between the two. However, the same studies have often shown Malaysia to be the exception, i.e. a country where defence prompts economic growth. We extended the time series through 1999 and found that indeed a clear positive relationship exists from defence spending to economic growth. While we recognize the vital role the military plays in the security of the nation, our results suggest that proposals to increase or decrease defence budgets in Malaysia can be argued on purely economic grounds.

APPENDIX

Malaysia, Real Rates of Growth (%)
Defence Burden and Gross Domestic Product, 1961 – 1999

Year	Real Rate of Growth (%) Defence Burden	Real Rate of Growth (%) GDP
1961	1.6	7.6
1962	1.8	6.4
1963	2.1	7.3
1964	2.7	5.4
1965	3.4	7.7
1966	4.0	7.8
1967	3.8	3.9
1968	3.7	8.0
1969	2.8	4.9
1970	3.6	6.0
1971	4.2	5.8
1972	5.0	9.4
1973	3.9	11.7
1974	4.2	8.3
1975	4.7	0.8
1976	4.0	11.6
1977	4.1	7.8
1978	3.7	6.7
1979	3.7	9.3
1980	4.2	7.4
1981	5.8	6.9
1982	5.9	5.9
1983	5.0	6.3
1984	3.3	7.8
1985	2.4	-1.1
1986	4.2	1.2
1987	4.5	5.4
1988	2.6	8.9
1989	2.9	9.2
1990	2.8	9.6
1991	3.5	8.6
1992	3.2	7.8
1993	3.2	8.3
1994	3.1	9.2
1995	2.9	9.5
1996	2.6	8.6
1997	2.2	7.5
1998	2.6	-7.5
1999	4.0	-1.7

Sources**: Defence Burden:** 1961-68 from <u>UN Statistical Yearbook</u>, United Nations: Washington, DC, annual issues; 1969-1985 from <u>Defence Spending in Southeast Asia</u>, ed. Chin Kin Wah, Institute of Southeast Asian Studies: Singapore, 1987, p. 174; 1985-1997 from <u>World Military Expenditures and Arms Transfers: 1998</u>, U.S. Department of State: Washington, DC, 2000; 1998-1997 from The International Institute for Strategic Studies, <u>The Military Balance: 2000-2001</u>, Oxford University Press: London, 2000. **GDP Growth Rates** from <u>Global Development Indicators: 2000</u>, World Bank: Washington, DC, 2000.

Notes

[1] See Emile Benoit, **Growth Effects of Defense Spending in Developing Countries**, *International Development Review*, Vol. 14, January 1972, pp. 2-10, and also Emile Benoit, **Growth and Defense in Developing Countries**, *Economic Development and Cultural Change*, Vol. 26, January 1978, pp. 271-80.

[2] Saadet Deger, *Military Expenditures in Third World Countries*, Routledge and Kegan Paul, London, 1986, p. xiii.

[3] For a good review, see Todd Sandler and Keith Hartley, *The Economics of Defense*, Cambridge University Press, Cambridge, 1995.

[4] *Ibid*., Chapter 8, "Economic Growth, Development, and Military Expenditures." pp. 200-220.

[5] When we use 1961 for example, we refer to growth from 1960 to 1961.

[6] Benoit (1978), pp. 275-76.

[7] Granger causality is discussed in the next section

[8] M.W.L. Chang, C. Hsiao, and C. Keng, **Defense Expenditures and Economic Growth in Developing Countries: A Temporal Cross Section Analysis**, in *Applied Time Series*, ed. by O.D. Anderson and M.R. Perryman, North Holland Publishing, Amsterdam, 1982.

[9] S. Chan, **The Impact of Defense Spending on Economic Performance: A Survey of Evidence and Problems**, *Orbis*, Vol. 26, Summer 1985, p.407.

[10] Wayne Joerding, **Economic Growth and Defense Spending: Granger Causality**, *Journal of Development Economics*, Vol. 21, 1986, pp. 35-40.

[11] *Ibid.*, p. 39.

[12] P. C. Frederiksen and C. J. LaCivita, **Defense Spending and Economic Growth: Time-Series Evidence on Causality for the Philippines, 1956-82**, *Journal of Philippine Development*, Vol. 14, Second Semester 1987, pp. 354-60.

[13] C. J. LaCivita and P.C. Frederiksen, **Defense Spending and Economic Growth: An Alternative Approach to the Causality Issue**, *Journal of Development Economics*, Vol. 35 , 1991, pp. 117-126.

[14] P. C. Frederiksen, **The Relationship between Defence Spending and Economic Growth: Some Evidence for Indonesia, 1964-85**, *Contemporary Southeast Asia*, Vol. 10, March 1989, pp. 375-384.

[15] P. C. Frederiksen, **Economic Growth and Defense Spending: Evidence on Causality for Selected Asian Countries**, *Journal of Philippine Development*, Vol. 18, Number 32, 1991, pp.131-147.

[16] Newman K. Kusi, **Economic Growth and Defense Spending: A Causal Analysis**, *Journal of Conflict Resolution*, Vol. 38, 1994, pp. 152-159.

[17] A. R. Chowdhury, **A Causal Analysis of Defense Spending and Economic Growth**, *Journal of Conflict Resolution*, Volume 35, 1991, pp. 80-97.

[18] Kusi, p. 157.

[19] Cheng Hsiao, **Autoregressive Modeling and Money-Income Causality Detection**, *Journal of Monetary Economics*, Vol. 7, January 1981, pp. 85-106.

[20] More detailed discussions of the technique can be found in Frederiksen (1991) and LaCivita and Frederiksen (1991).

[21] Other examples of using this technique occur frequently in the literature. See for example, N. Manage and M.L. Marlow, **The Causal Relation between Government Revenue and Government Expenditure**, *Southern Economic Journal*, Vol. 52, 1986, pp. 617-629.